TRAFFIC CONTROL USING FUZZY LOGIC

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Abstract:

This paper describes the application of fuzzy logic to the design of a Fuzzy Traffic Light Controller. The fuzzy controller changes the cycle time of the lights depending upon the observed accumulation of cars behind the green and red lights and the current cycle time. The objective is to optimize the car flow through the lights and minimize wait time. A fuzzy model is being implemented and tested to predict the behavior of the model under different traffic conditions.

In a conventional traffic light controller, the lights change at constant cycle time, which is clearly not the optimal solution. Fuzzy logic can be a better method than conventional control methods, especially in the case of highly uneven traffic flow between different directions**.** It would be more feasible to let more cars pass at the green light if there is less number of cars behind the red lights. A mathematical model for this decision is difficult to find but fuzzy logic simplifies the task. Once well working and appropriate rules are formulated for our four way intersection, it is not too difficult to modify the fuzzy rule base so that the program can be applied to any given intersection.

In order to determine the traffic flow in each direction, two incremental sensors are to be placed in each direction at a distance of 200 feet from each other, for a total of eight sensors. The number of cars that is accumulated behind a traffic light is calculated by taking the difference between the two sensor readings.

The input of this model consist of:

1. Current cycle time of light.
2. Accumulation Of Cars behind The Red Light on more crowded street side.
3. Accumulation Of Cars behind The Green Light on more crowded street side.

The output parameter is the probability of change of the current cycle time.

The input and the output parameters are defined by overlapping linear membership functions.

The knowledge base consists of 110 fuzzy rules, as for example:

1. If traffic accumulation behind red is very minimal and green is very minimal and cycle time is short then change is NO.
2. If traffic accumulation behind red is moderate and green is moderate and cycle time is long then change is PROBABLY YES

Some of the rules have been evaluated by using the fuzzy logic formulas

$\mu_{B'}(y) = \max_{x1\ldots xn} [\min(\mu_{A1(x1)} \ldots\ldots\ldots \mu_{An(xn)}),\ \mu_{A1\ldots An \to B}(x_1, \ldots, x_n, y)$

$\mu_{A1\ldots An \to B}(x_1, \ldots, x_n, y) = \max((1-\min(\mu_{A1(x1)} \ldots\ldots\ldots \mu_{An(xn)}), \mu_B(y))$

Test cases are being generated and the error value for n test cases is calculated using the formula: $\Sigma\ 1/n * (\text{simulated output} - \text{desired output})^2$

The error value is very small and negligible, which allows us to conclude that the rules are strong and have very small error values.